I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Mail Stop Amendment, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on January 27, 2006.

Daniel F. Nesbitt

JAN 3 1 2006 IAP58 PATENT & TRADEMARK OFFICE

Docket No.: DU-002-01
Serial No.: 10/790,410

## IN THE UNITED STATES PATENT & TRADEMARK OFFICE

| | | | | |
|---|---|---|---|---|
| Applicant: | Akbar HUSSAINI, et al. | : | Confirmation No.: | 1458 |
| Serial No.: | 10/790,410 | : | Group Art Unit.: | 1714 |
| Filing Date: | March 1, 2004 | : | Examiner: | K.A. Sanders |
| For: | APPLICATOR HEAD FOR APPLYING FLUID MATERIAL TO SUBSTRATE | | | |

## DECLARATION UNDER 37 CFR 1.131

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

We, Akbar Syed Hussaini, Silveiro Rodrigues, and Michael Jess Antoinie, do hereby declare as follows:

1. We are the inventors of the subject matter described and claimed in the above-identified patent application.

2. Before April 24, 2003, the filing date of U.S. Patent 6,872,761 B2 to LeStarge, we conceived and reduced to practice in the United States the invention described and claimed in Claim 14 and Claim 23 in the above application, as evidenced by the following attached copies of H.B. Fuller Invention Record 02-002, Research Notebook SR129, page 1, and a consultant's report from Kolano and Saha Engineers, Inc.

| | |
|---|---|
| Invention Record 02-002 | 3 pages |
| Research Notebook SR129, page 1 | 1 page |
| Kolano and Saha Engineers, Inc. report | 8 pages |

True copies of the above pages, with all dates and unrelated information expunged, are attached. All such dates are prior to April 24, 2003.

3. Before April 24, 2003, embodiments of the invention claimed in the above application were made and tested by us or and under our supervision, as described in the above documents.

4. Invention Record 02-002 (IR 02-002) is a document dated before April 24, 2003. IR 02-002 describes a waterborne sound damping coating for bake resistance (between 124°C and 191°C) that provides improved sound damping and rheological properties at a high surface thickness (up to 5 mm), and shows improved low frequency vibration damping. Examples of formulations of the composition, denoted EF3030, is shown on the third page.

5. Research Notebook SR129, page 1 (SR129-1) is a document dated before April 24, 2003. SR129-1 shows a formula card for a bakeable (pre-baked) waterbase damper composition, including the ingredient names, types and target levels, the amount of each ingredient used, and the mixing procedure for making the composition. Also shown are the physical tests conducted on the pre-baked composition, including the density and the viscosity of the pre-baked composition. Also shown are the curing conditions, referred to as "drawdown" conditions, for preparation of samples of the post-baked composition on a substrate.

Specifically, SR129-1 shows a formula for the product entitled "EF3030. The pre-baked composition comprises 22% by weight n-butyl acrylate-acrylonitrile-styrene copolymer (40% by weight Acronal S504, a 55% solution in water), 2.5% by weight low-density glass bead filler (2.5% by weight Scotchlite® Bubble VS 5500 (glass)), 43.85% by weight additional fillers (31.52% by weight GPR 200 limestone and 12.31% by weight dry ground mica 4K), and 2.005% by weight rheology modifier (0.08% by weight Acrysol RM-8W, 1.425% by weight Acusol 820, and 0.50% by weight Attagel 30). SR129-1 also states that the pre-baked composition had a viscosity of 76,500 centipoises (cps), and a density of 10.5 lbs per gallon, about 1.25 g/cc, each property within the target range.

The drawdown times and temperatures for the compositions were conducted at four sets of conditions shown in SR129-1.

6. Kolano and Saha Engineers, Inc. report (K&S Report) is a document dated before April 24, 2003. K&S Report shows a vibration damping testing report prepared by the consultant after performing various sound damping tests on a sample of the post-baked sound damping composition applied to a substrate. K&S Report shows the sound-damping response of the post-baked compositions in the sub-Exhibits 1T-4T to the report.

Specifically, K&S Report shows that the pre-baked sound damping composition of the EF3030 product was applied to the test bars at a thickness ranging from 0.9 mm to 5.9 mm, and cured for 25 minutes at 165°C. The sample bars were then tested at five test temperatures each for sound damping performance.

7. The following statements explain how the compositions and methods described in above documents relate to the subject matter of Claim 14 and 23 in the above application.

<u>Claim 14:</u>

IR 02-002 and SR129-1 show an invention of a composition that was conceived and reduced to practice before April 24, 2003, comprising n-butyl acrylate-acrylonitrile-styrene copolymer (40% by weight Acronal S504, a 55% solution in water), low-density glass bead filler (2.5% by weight Scotchlite® Bubble VS 5500 (glass)), additional fillers (31.52% by weight GPR 200 limestone and 12.31% by weight dry ground mica 4K), and rheology modifier (0.08% by weight Acrysol RM-8W, 1.425% by weight Acusol 820, and 0.50% by weight Attagel 30). The pre-baked composition had a composition viscosity of 76,500 cps and a density of about 1.25 g/cc. The composition viscosity is within the target range of 60,000 – 1000,000 cps, established by the inventors to control sag and slide of the composition on a substrate.

K&S Report shows that the composition made according to SR129-1 provides a sound-damping response.

<u>Claim 23:</u>

IR 02-002 and SR129-1 show an invention of a composition that was conceived and reduced to practice before April 24, 2003, comprising a polymeric system (n-butyl acrylate-acrylonitrile-styrene), low-density glass bead filler (Scotchlite® Bubble VS 5500 (glass)),

additional fillers (GPR 200 limestone and dry ground mica 4K), and at least one rheology modifier (Acrysol RM-8W, Acusol 820, and Attagel 30). The pre-baked composition had a density of about 1.25 g/cc.

K&S Report shows that the compositions made according to SR129-1 provide a sound-damping response, and that the baked compositions have a lower density, in the range of about 0.46 to 0.80, that that of the pre-baked composition.

8. All acts described herein were conducted in the United States before April 24, 2003 with respect to Invention Record 02-002, Research Notebook SR129, page 1, and the Kolano and Saha Engineers, Inc. report.

We further declare that all statements made of our knowledge are true and that all statements made on information and belief are believed to be true; further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 USC 1001 and may jeopardize the validity of the application or any patent issuing thereon.

| | |
|---|---|
| Date | Akbar Syed Hussaini |
| Date | Silveiro Rodrigues |
| Date | Michael Jess Antoinie |

18 USC 1001: *"Whoever in any matter within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals or covers up by any trick, scheme, or device a material fact, or makes any false, fictitious or fraudulent statements or representations, or makes or uses any false writing or document knowing the same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both."*

additional fillers (GPR 200 limestone and dry ground mica 4K), and at least one rheology modifier (Acrysol RM-8W, Acusol 820, and Attagel 30). The pre-baked composition had a density of about 1.25 g/cc.

K&S Report shows that the compositions made according to SR129-1 provide a sound-damping response, and that the baked compositions have a lower density, in the range of about 0.46 to 0.80, that that of the pre-baked composition.

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We further declare that all statements made of our knowledge are true and that all statements made on information and belief are believed to be true; further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 USC 1001 and may jeopardize the validity of the application or any patent issuing thereon.

| | |
|---|---|
| 1/26/06<br>Date | Akbar Syed Hussaini |
| 1/26/06<br>Date | Silveiro Rodrigues |
| 1/26/06<br>Date | Michael Jess Antoinie |

18 USC 1001: *"Whoever in any matter within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals or covers up by any trick, scheme, or device a material fact, or makes any false, fictitious or fraudulent statements or representations, or makes or uses any false writing or document knowing the same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both."*

HBF: 02-002

FORM A

(Patent Department fills this in)

RECEIVED

[redacted] 4/30/01

H.B. FULLER PATENT DEPT.

# H.B. FULLER COMPANY
## CONFIDENTIAL INVENTION DISCLOSURE

**Inventors:** Akbar Hussaini, Silveiro Rodrigues

**Department Name/Department (Billing)# /Department Manager Name:**
EFTEC Waterborne Group/ Billing #700700.135.0101.145/M. Pellay or T. Zhizek

**Disclosure Title:** Bakeable Light Weight Waterbase Sound Deadener

**Technology Area:** ☐ Waterbase ☐ Hot Melt ☐ Thermoset ☐ Reactive ☐ Other
(check one)

**Include:** *(Type all the information, if possible, in the following pages and inventor(s) sign each page)*

1) Describe the invention including ingredients of a composition (or a product) or steps of a process.

2) Describe the utility of the invention, the difference(s) and advantage(s) over previous approaches.

3) Provide examples that illustrate the invention.

4) Identify all people (inventors) who have contributed to this invention.

5) List and attach any other relevant information such as patent and literature searches, internal reports, drawings, etc. SAE Paper 2000-01-1391

6) Provide notebook pages showing the invention date. Lab book SR125-SR130

7) Is this invention potentially a trade secret?

8) Has the associated product been sampled and/or sold? Yes/No (circle one) If yes,
   (a) Please indicate when
   (b) Was a secrecy agreement signed? Yes/No (circle one)
   (c) What is the associated product name(s) or number(s)? EF 3030

9) List the LPS project number related to this invention.

10) List any other HBF patent disclosure, patent application or granted patent that is related to this disclosure.

Check the ONE MOST PERTINENT business area:

| Industrial Products | Performance Products | Specialty | Full-Valu | Other |
|---|---|---|---|---|
| ☐ Non-woven | ☐ Footwear | ☐ GCD | ☐ Linear | ☐ EFTEC |
| ☐ Converting | ☐ Assembly | ☐ Liquid Paints | ☐ AGS | ~~☐ Fiber-Resin~~ |
| ☐ Tape & Label | ☐ Packaging | ☐ Foster | ☐ Window | |
| ☐ Graphic Arts | | ☐ TEC | ☐ LCT | |
| | | ☐ Consumer Products | ☐ NBD | |

Send Original Form A to: Patent Department, WLB-2

## INVENTION DISCLOSURE DESCRIPTION

This invention and its derivatives are acrylic based high solids (73-83%) waterborne sound damper coatings/sealers for bake resistance (124°C to 191°C) primarily used in the automotive, industrial and appliance industries. This product's density (1.5 ± 0.2 g/cc) allows for excellent sound damping and rheological properties at high surface thicknesses (up to 5mm). The composition has excellent adhesion to a variety of substrates (electrocoat, engineered plastics, and stainless steels). The primary objective of this invention is best described as a feasible and automated method to replace manually applied (labor intensive) die-cut or mastic sound deadening pads. The material has shown improved low frequency vibration damping (0-1000 Hz) over previously developed sound damping coatings and/or die cut sound pads at same surface weights. This invention allows the NVH (Noise Vibration and Harshness) Engineer at a customer to coat his/her part with less material weight and less coverage than previous treatments without compromising sound qualities. This invention has also found use in the automotive exterior wheelhouse and underbody applications as an anti-chip, sealer and blackout coating. Also, for automotive interiors, the increased elasticity over its predecessors has allowed this product to be used as an interior seam sealer. For industrial and appliance applications (sinks, dishwashers etc), this invention also allows the OEM Engineer to reduce "airborne noise" (sound transmittance) with less material usage and coverage than previous or historical treatments (pads and thin film coatings).

This product (EF3030) consists of 25-45 % n-butyl acrylate-acrylonitrile-styrene copolymer. Derivatives of this invention have portions (10% or less) based around glycidyl methacrylate functional multipolymer acrylic and/or dispersion of acrylic ester copolymer and/or asphaltic emulsion with specific glass transition temperatures. Variations may be employed to shift peak damping response temperature above or below the current 25°C as required. Fillers (45-65%) include dolomitic limestone, limestone, calcium carbonate, plastic micropsheres, glass bubbles and mica. The composition also includes (<5%) rheological modifiers and other additives (<5%) for sag/slide resistance and shelf stability respectively.

At specified surface weights, typical bakeable, air dry waterborne coatings or other low frequency vibration damping coatings (epoxy or PVC based) do not fully exceed die-cut sound pads for the entire temperature range between –20° to 60°C. With this waterborne coating EF3030, the damping response out performs sound pads and other coatings at all temperatures between –20 and 60°C using SAEJ1637 Oberst Bar method at 2.44 kg/m$^2$.

| Described by: (Inventor(s)) | Read & Understood by: (Witness) |
|---|---|
| AKBAR HUSSAINI | JOHN CHACKO |
| Print or type name | Print or type name |
| Signature [signature] | Signature John M. Chacko |
| Date [redacted] | Date [redacted] |

Send Original Form A to: Patent Department, WLB-2

Date: [redacted]

Product: EF3030 Formulations

| IBM# | Raw Material Description | A % | B % | C % |
|---|---|---|---|---|
| 21-0107 | Water | 3.0500 | 3.0500 | 3.0500 |
| 14-0052 | PROPYLENE GLYCOL | 4.0000 | 4.0000 | 4.0000 |
| 02-1051 | Hydropalate 100 | 0.9000 | 0.9000 | 0.9000 |
| 02-0528 | Pluronic F87 Prill surfactant (30% Sol. In water) | 0.9000 | 0.9000 | 0.9000 |
| 19-0859 | Attagel 30 | 2.5000 | 2.5000 | 2.5000 |
| 26-1727 | Acronal S504 | 40.0000 | 35.0000 | 35.0000 |
| 26-2124 | Acronal A 378 | 0.0000 | 5.0000 | 0.0000 |
| PN-3610K | GMA | 0.0000 | 0.0000 | 5.0000 |
| 07-0220 | KATHON LX | 0.0200 | 0.0200 | 0.0200 |
| 18-0200 | Aurasperse W-7017 | 0.2000 | 0.2000 | 0.2000 |
| 19-1476 | GPR 200 Limestone | 31.8300 | 31.8300 | 31.8300 |
| 21-0107 | Water | 0.2400 | 0.2400 | 0.2400 |
| 28-1236 | Acrysol RM-8W | 0.0800 | 0.0800 | 0.0800 |
| 19-1066 | Dry Ground Mica 4K | 12.3100 | 12.3100 | 12.3100 |
| 19-1414 | Expancel DU 092-120 | 0.0200 | 0.0200 | 0.0200 |
| 19-1456 | Duolite M6050AE | 0.2500 | 0.2500 | 0.2500 |
| 19-1155 | Scotclite Bubbles VS 5500 (Glass) | 2.5000 | 2.5000 | 2.5000 |
| 02-0102 | AMP-95 | 0.0500 | 0.0500 | 0.0500 |
| 26-0599 | Acusol 820 rheology modifier | 0.8000 | 0.8000 | 0.8000 |
| 03-0241 | Rhodoline 646 | 0.3500 | 0.3500 | 0.3500 |
| | TOTAL | 100.0000 | 100.0000 | 100.0000 |

| | | | |
|---|---|---|---|
| Lab# | SR129-1 | work | R&D |
| Product | Bakeable waterbase damper | size | 5.0 gal (just right size) |
| Customer | [redacted] | scale# | $0 44/lb |
| Spec# | TBD | oven# | 6 & 26 / $4 20/gal |
| Aim | Finalize the formula for Tox submission | oven# | 3 |
| Ref | SR126M typo, to improve foam effect and sound dampening | oven# | 10 |
| Tech | SR/PMG | Project# | WN99059 |
| Date | [redacted] | Product# | EF3030 |
| EF3030: | For application study by [redacted] | | |
| Mixer | Air mixer using Cowles blade | | |

| Order | IBM# | Raw Material Description | % | Amount, G | Mix Procedure: |
|---|---|---|---|---|---|
| 1 | 21-0107 | Water | 3.0500 | 732.0 | Add 1 to 4 and enough of Acronal S 504 |
| 2 | 18-0200 | Aurasperse W-7017 | 0.1000 | 24.0 | stir in Plastic container |
| 3 | 19-0859 | Attagel 30 | 0.5000 | 120.0 | to a paste before adding anything else |
| 4 | 19-0024 | ASP 400 | 4.0000 | 960.0 | |
| 5 | 26-1727 | Acronal S504 | 40.0000 | 9600.0 | Add remaining 4 to 9 and stir in Plastic container |
| 7 | 03-0241 | Rhodoline 646 | 0.2500 | 60.0 | |
| 8 | 02-0528 | Pluronic F87 Prill surfactant (30% Sol. in water) | 0.4500 | 108.0 | Add 10, 11, 12. as mixing, + extra mixing |
| 9 | 14-0052 | PROPYLENE GLYCOL | 1.5000 | 360.0 | Mix thoroughly to a smooth paste. |
| 10 | 07-0220 | KATHON LX | 0.0200 | 4.8 | Add 10 as mixing for 3 min |
| 11 | 19-1476 | GPR 200 Limestone | 31.5200 | 7564.8 | Add 12 as mixing & mix for 3 min more |
| 12 | 19-1066 | Dry Ground Mica 4K | 12.3100 | 2954.4 | Add 13 as mixing & mix for 3 min more |
| 13 | 19-1414 | Expancel DU 092-120 | 0.0200 | 4.8 | Add 14 & 15 as mixing and Thixotophy should develop. |
| 14 | 14-0052 | PROPYLENE GLYCOL | 2.5000 | 600.0 | Add 16.17 & 18 as mixing and finish batch (2min mixing) |
| 15 | 19-1456 | Duolite 6050AE | 0.2500 | 60.0 | Run viscosity. If meets the requirement |
| 16 | 19-1155 | Scotchlite Bubbles VS 5500 (Glass) | 2.5000 | 600.0 | |
| 17 | 02-0102 | AMP-95 | 0.0500 | 12.0 | |
| 18 | 28-1236 | Acrysol RM-8W | 0.0800 | 19.2 | |
| 19 | 26-0599 | Acusol 820* rheology modifier | 1.4250 | 342.0 | |
| 20 | 03-0241 | Rhodoline 646 | 0.1000 | 24.0 | latex=40 00% |
| | | TOTAL | 100.6250 | 24150.0 | filler= 51 10% |
| | | * Predisperse Acrysol TT-615 Rheology modifier in water at 1:1 | | | addetives= 8 84% |

| | | initial | 1day |
|---|---|---|---|
| initial SPEC | TEST | | |
| 60k - 100k cps | 20 rpm,cpoise, #7 sp; 77°F; 1' reading | 76,500 | 89,000 |
| 35-55 sec | CS; 0.125/10 psi; 50 g @ 77F | 42.0 | 75.2 |
| | Regular tip application | | |
| | swirl application | | |
| 70% min. | Theoretical % solids | 71.00% | |
| 70% min. | Actual % solids, 2g for 1hr @ 220°F | 71.50% | |
| 1.2 - 1.44 | Sp. Gravity (1.20 -1.44) | 1.26 | |
| 11.0 ± 1.0 lb | Wt/Gal; lb (9.5 - 12.5) | 10.50 | |
| | DRAW DOWN 100x25x1.5 mm wet on ED panel wait for 10-15' | | |
| | 10' @ 250°F + 30' @300°F + 30' @ 266°F | | |
| | DRAW DOWN 100x25x1.5 mm wet on ED panel wait for 10-15' | | |
| | 30' @ 300°F + 30' @266°F | | |
| | DRAW DOWN 100x25x1.5 mm wet on ED panel wait for 10-15' | | |
| | 10' @ 285°F + 30' @290°F + 30' 266°F | | |
| | DRAW DOWN 100x25x1.5 mm wet on ED panel wait for 10-15' | | |
| | 10' @ 250°F + 30' @325°F + 30' @ 266°F | | |
| cf | Adhesion** (0 no adhesion-10 exc) | | |
| | Heat age; 3d 110F | | |
| | 20 rpm | | |
| | CS; 0.125/10 psi; 50 g @ 77F | | |
| | Young's Modulus | | |
| | Sag point (3 mm min) | | |
| 5 pli | 180° peel adhesion**, pli | | |
| 2"/min pull | Tensile**, psi, Wait 2 HR after bake | | |
| 15% min | Elongation**; % | | |

** 5 - 10 min wait at RT + 10' @ 250°F + 30' @300°F + 30' @ 266°F    § non vac

cracking scale (0 no crack - 10 severe cracking)

K&S

**Kolano and Saha Engineers, Inc.**
Consultants in Acoustics, Noise and Vibration

2001-189

[redacted]

Mr. Akbar Hussaini
EFTEC North America, LLC
31601 Research Park Drive
Madison Heights, MI 48071

Subject: **Results of Oberst Bar Vibration Damping Tests of Spray-on Damping Materials**
EFTEC North America, LLC Purchase Order No. 34778
Kolano and Saha Engineers, Inc. Project No. 2001-189

Dear Mr. Hussaini:

This letter reports the results of Oberst bar damping tests of one waterbased/spray-on damping material (EF 3030) that you provided us. The study involved determining the damping performance of this material at different thickness. The results are expressed in terms of composite loss factor obtained using the Oberst Bar test method. Later, further computation was conducted to obtain composite and material Young's Modulus, and material loss factor. Test procedures followed for these measurements were in accordance with the test method described per the SAE Recommended Practice J1637-93, *Laboratory Measurement of the Composite Vibration Damping Properties of Materials on a Supporting Steel Bar.*

It should be noted that a similar, but more detailed study was done earlier this year (Kolano and Saha Engineers, Inc.) Project No. 2001-039 dated [redacted]) on material EF 3000. The material EF 3030 that is discussed in this report has the same surface weight and cure condition as that of the EF 3000 in four specific cases.

## Test Sample

The samples that were tested are as follows:

| Sample No. | Sample Description | Measured Data Thickness (mm) | Surf. Wt. ($kg/m^2$) | Test Temp. (°C) |
|---|---|---|---|---|
| 1 | EF 3030 | 0.9 | 0.7 | 60,40,25,10,-10 |
| 2 | EF 3030 | 2.7 | 1.3 | 60,40,25,10,-10 |
| 3 | EF 3030 | 4.4 | 2.6 | 60,40,25,10,-10 |
| 4 | EF 3030 | 5.9 | 4.0 | 60,40,25,10,-10 |

The cure condition for all the samples were High/Nominal 25 min @ 165° C. This is the same cure condition as that of Samples 7, 3, 15, and 23 (Exhibits 7T, 3T, 15T, and 23T).



3559 Sashabaw Road · Waterford, MI 48329-2656 · (248) 674-4100 · Fax (248) 674-3755

All samples were prepared by EFTEC. The dimensions of these bars were: total length 225 mm, free length 200 mm, thickness 0.8 mm, and width 12.7 mm (Figure 1).

In this study no bare steel bars were tested. However, the average resonant frequency data of the bare bar resonance needed to compute material properties was obtained from an earlier project done for EFTEC (Kolano and Saha Engineers, Inc. Project No. 2001-039 dated [redacted]). Results obtained from measurements made on bare bars and damped bars were used to compute material loss factor and material Young's modulus. ASTM Standard E756 provides the equations that were used for computing material properties and are listed in Attachment A. It should be noted that the ASTM Standard also mentions the precautions that one should take into account and the limitations that one should be aware of regarding the valid use of these equations.

## Measurements

Tests were made on a fixture to measure modes of vibration of the test sample using a random noise signal. The resonant frequency and the half power bandwidth (frequency difference between 3 dB downpoints from the resonant peak) of each mode needed for composite loss factor ($\eta_c$) computation, were read directly from a dual channel signal analyzer (B&K Type 2032). Any deviation from this procedure if applicable is mentioned in the data sheets. A complete description, and calibration records of the instrumentation used are on file with K&SE.

It also should be noted that not always the 3 dB down points on both sides of the resonant frequency were measurable. In such cases the "n" dB down point method was used wherever possible per SAE Standard J1637-93.

## Results

Results of these tests are presented in tabular form in Exhibits 1T through 4T. These exhibits provide the composite loss factor and composite Young's modulus plus the material loss factor and material Young's modulus data at each mode of vibration at a given temperature wherever it could be computed. The numbers 1 through 4 are also the identifications of the test bars.

The tables also show the interpolated values at 200 Hz, 400 Hz, and 800 Hz for each temperature. These values are based on linear interpolation of two sets of data points where the frequency and the loss factor (or the modulus) information are provided in a logarithmic scale. According to this technique, the damping performance at 200 Hz (as an example) is interpolated by intersecting the 200 Hz frequency line (i.e. the vertical line) and the straight line connecting the damping (or modulus) performance values for the resonant frequencies directly on either side of 200 Hz. Likewise, interpolation at 400 or 800 Hz is computed by intersecting the 400 or 800 Hz frequency line and the straight line connecting the loss factor (or modulus) values for the resonance, directly on either of 400 or 800 Hz, respectively. It should be noted that due to the limitation of the equation (used in computing material properties) as mentioned earlier and that all modes could not always be measured, not all data could be computed. In such cases the interpolated data of composite loss factor, composite Young's modulus, material loss factor, and material Young's modulus are left blank.

Exhibits 1GA through 4GA show the composite loss factors of the material at the five test temperatures that is described in report 2001-039 in graphical form. Exhibits 1GB through 4GB show the composite loss ($7_c$), and the composite Youngs Modulus ($E_c$), at 200, 400, and 800 Hz. For ease of comparing the results of EF 3030 that could be compared with that of EF 3000 (Project 2001-039) are provided as Exhibits 7T-1T, Exhibits 3T-2T, Exhibits 15T-3T, and Exhibits 23T-4T respectively.

---

Mr. Hussaini, we appreciate this opportunity to be of service to EFTEC. Please telephone me should you have any questions or comments regarding the data. We are looking forward to working together again in the future.

Sincerely,

**KOLANO AND SAHA ENGINEERS, INC.**

Wayne P. Miller

Wayne P. Miller
Technician

Approved by:

Pranab Saha

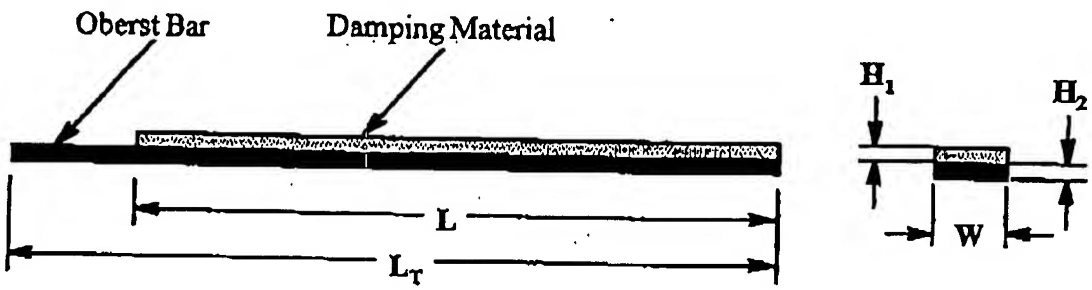
Pranab Saha, Ph.D., P.E.
Principal Consultant

WPM:lps

Figure 1

# TEST SAMPLE FOR OBERST BAR DAMPING TESTS

## Bar Without Roots




**LEGEND**

**L** = Free Length of the Oberst Bar: 200 mm (7.87 in.)
This is also the Length of the Damping Material

**$L_T$** = Total Length of the Oberst Bar: 225 mm (8.86 in.)

**W** = Width of the Oberst Bar: 12.7 mm (0.5 in.)

**$H_2$** = Thickness of the Oberst Bar in the Vibration Direction: 0.8 mm (0.031 in.)

**$H_1$** = Thickness of the Damping Material

## VIBRATION DAMPING PROPERTIES

**Material Supplier:** EFTEC North America, LLC
**Sample Description:** EF3030 (1) **Cure Condition:** N/A
**Material Type:** Sprayon waterbase/extensional layer **Classification:** 6

| Sample Information | | Manf. Data | Measured Data | Steel Bar | Units |
|---|---|---|---|---|---|
| | Surface Wt: | 0.6 | 0.7 | 6.3 | kg/m$^2$ |
| | Density: | N/A | 797 | 7936 | kg/m$^3$ |
| | Thickness: | N/A | 0.9 | 0.8 | mm |

| TEST TEMPERATURE | Measured Data | | | Computed Data | | |
|---|---|---|---|---|---|---|
| | MODE | RESONANT FREQUENCY $f_c$ (Hz) | COMPOSITE LOSS FACTOR $\eta_c$ | COMP. YOUNG'S MODULUS $E_c$ (Pa) | MATERIAL LOSS FACTOR $\eta_1$ | MAT. YOUNG'S MODULUS $E_1$ (Pa) |
| -10°C (14°F) | 2 | 117 | 0.009 | 5.97E+10 | 0.030 | 5.74E+09 |
| | 3 | 330 | 0.008 | 6.02E+10 | 0.027 | 5.79E+09 |
| | 4 | 645 | 0.007 | 6.00E+10 | 0.024 | 5.67E+09 |
| | 5 | 1055 | 0.007 | 5.87E+10 | 0.025 | 5.19E+09 |
| | 6 | 1562 | 0.007 | 5.77E+10 | 0.027 | 4.85E+09 |
| | Interpolated | 200 | 0.008 | 6.00E+10 | 0.028 | 5.77E+09 |
| | | 400 | 0.008 | 6.02E+10 | 0.026 | 5.76E+09 |
| | | 800 | 0.007 | 5.95E+10 | 0.025 | 5.45E+09 |
| 10°C (50°F) | 2 | 111 | 0.033 | 5.32E+10 | 0.150 | 3.71E+09 |
| | 3 | 314 | 0.031 | 5.46E+10 | 0.133 | 4.04E+09 |
| | 4 | 617 | 0.026 | 5.49E+10 | 0.111 | 4.08E+09 |
| | 5 | 1014 | 0.023 | 5.43E+10 | 0.103 | 3.84E+09 |
| | 6 | 1507*4 | 0.024 | 5.38E+10 | 0.112 | 3.64E+09 |
| | Interpolated | 200 | 0.032 | 5.40E+10 | 0.140 | 3.89E+09 |
| | | 400 | 0.029 | 5.47E+10 | 0.125 | 4.05E+09 |
| | | 800 | 0.024 | 5.46E+10 | 0.107 | 3.95E+09 |
| 25°C (77°F) | 2 | 103 | 0.042 | 4.61E+10 | 0.393 | 1.53E+09 |
| | 3 | 294*2 | 0.045 | 4.78E+10 | 0.343 | 1.95E+09 |
| | 4 | 581 | 0.047 | 4.87E+10 | 0.328 | 2.17E+09 |
| | 5 | 963 | 0.044 | 4.89E+10 | 0.306 | 2.19E+09 |
| | 6 | 1437 | 0.042 | 4.89E+10 | 0.297 | 2.16E+09 |
| | Interpolated | 200 | 0.044 | 4.72E+10 | 0.360 | 1.78E+09 |
| | | 400 | 0.046 | 4.82E+10 | 0.336 | 2.05E+09 |
| | | 800 | 0.045 | 4.88E+10 | 0.314 | 2.18E+09 |
| 40°C (104°F) | 2 | 100 | 0.013 | 4.33E+10 | | |
| | 3 | 282*3 | 0.018 | 4.41E+10 | | |
| | 4 | 555 | 0.026 | 4.44E+10 | | |
| | 5 | 917 | 0.031 | 4.44E+10 | | |
| | 6 | 1371 | 0.047 | 4.45E+10 | | |
| | Interpolated | 200 | 0.016 | 4.39E+10 | | |
| | | 400 | 0.022 | 4.43E+10 | | |
| | | 800 | 0.030 | 4.44E+10 | | |
| 60°C (140°F) | 2 | 99 | 0.006 | 4.28E+10 | | |
| | 3 | 278 | 0.007 | 4.29E+10 | | |
| | 4 | 545 | 0.016 | 4.28E+10 | | |
| | 5 | 901 | 0.045 | 4.28E+10 | | |
| | 6 | 1378 | 0.061 | 4.50E+10 | | |
| | Interpolated | 200 | 0.007 | 4.28E+10 | | |
| | | 400 | 0.011 | 4.28E+10 | | |
| | | 800 | 0.035 | 4.28E+10 | | |

*2- 2dB downpoint method
*3- 3dB downpoint one side method
*4- Calculated from printout

Measurements Conducted per SAE J1637
Bar Free Length: 200 mm

Kolano and Saha Engineers, Inc.
Project No. 2001-189
Test Date: [redacted]

## VIBRATION DAMPING PROPERTIES

**Material Supplier:** EFTEC North America, LLC
**Sample Description:** EF3030 (2) **Cure Condition:** N/A
**Material Type:** Sprayon waterbase/extensional layer **Classification:** 11

| | | Manf. Data | Measured Data | Steel Bar | Units |
|---|---|---|---|---|---|
| Sample Information | Surface Wt: | 1.3 | 1.3 | 6.3 | $kg/m^2$ |
| | Density: | N/A | 458 | 7936 | $kg/m^3$ |
| | Thickness: | N/A | 2.7 | 0.8 | mm |

| TEST TEMPERATURE | MODE | Measured Data: RESONANT FREQUENCY $f_c$ (Hz) | Measured Data: COMPOSITE LOSS FACTOR $\eta_c$ | Computed Data: COMP. YOUNG'S MODULUS $E_c$ (Pa) | Computed Data: MATERIAL LOSS FACTOR $\eta_1$ | Computed Data: MAT. YOUNG'S MODULUS $E_1$ (Pa) |
|---|---|---|---|---|---|---|
| -10°C (14°F) | 2 | 152 | 0.017 | 7.96E+09 | 0.028 | 1.39E+09 |
| | 3 | 420 | 0.015 | 7.75E+09 | 0.025 | 1.32E+09 |
| | 4 | 826 | 0.014 | 7.82E+09 | 0.024 | 1.34E+09 |
| | 5 | 1371 | 0.014 | 7.88E+09 | 0.024 | 1.35E+09 |
| | | | | | | |
| | Interpolated | 200 | 0.016 | 7.90E+09 | 0.027 | 1.37E+09 |
| | | 400 | 0.015 | 7.76E+09 | 0.025 | 1.33E+09 |
| | | 800 | 0.014 | 7.82E+09 | 0.024 | 1.34E+09 |
| 10°C (50°F) | 2 | 136 | 0.072 | 6.34E+09 | 0.140 | 9.30E+08 |
| | 3 | 383 | 0.058 | 6.44E+09 | 0.112 | 9.50E+08 |
| | 4 | 758 | 0.052 | 6.58E+09 | 0.099 | 9.86E+08 |
| | 5 | 1267 | 0.049 | 6.73E+09 | 0.092 | 1.02E+09 |
| | | | | | | |
| | Interpolated | 200 | 0.066 | 6.38E+09 | 0.129 | 9.38E+08 |
| | | 400 | 0.058 | 6.45E+09 | 0.111 | 9.53E+08 |
| | | 800 | 0.052 | 6.60E+09 | 0.098 | 9.90E+08 |
| 25°C (77°F) | 2 | 110 | 0.127 | 4.15E+09 | 0.471 | 3.14E+08 |
| | 3 | 320 | 0.130 | 4.51E+09 | 0.404 | 4.07E+08 |
| | 4 | 642 | 0.135 | 4.73E+09 | 0.387 | 4.64E+08 |
| | 5 | 1100 | 0.131 | 5.07E+09 | 0.336 | 5.57E+08 |
| | | | | | | |
| | Interpolated | 200 | 0.129 | 4.35E+09 | 0.433 | 3.63E+08 |
| | | 400 | 0.132 | 4.58E+09 | 0.399 | 4.25E+08 |
| | | 800 | 0.133 | 4.86E+09 | 0.365 | 5.00E+08 |
| 40°C (104°F) | 2 | 100 | 0.037 | 3.47E+09 | | |
| | 3 | 285 | 0.056 | 3.58E+09 | | |
| | 4 | 566 | 0.067 | 3.67E+09 | | |
| | 5 | 952 | 0.087 | 3.80E+09 | | |
| | 6 | 1420 | 0.108 | 3.79E+09 | | |
| | Interpolated | 200 | 0.049 | 3.54E+09 | | |
| | | 400 | 0.061 | 3.62E+09 | | |
| | | 800 | 0.080 | 3.75E+09 | | |
| 60°C (140°F) | 2 | 98 | 0.011 | 3.31E+09 | | |
| | 3 | 277 | 0.017 | 3.37E+09 | | |
| | 4 | 545 | 0.022 | 3.40E+09 | | |
| | 5 | 905 | 0.025 | 3.44E+09 | | |
| | 6 | 1355 | 0.029 | 3.45E+09 | | |
| | Interpolated | 200 | 0.015 | 3.35E+09 | | |
| | | 400 | 0.020 | 3.39E+09 | | |
| | | 800 | 0.024 | 3.43E+09 | | |



Measurements Conducted per SAE J1637
Bar Free Length: 200 mm

Exhibit 3T

Kolano and Saha Engineers, Inc.
Project No. 2001-189
Test Date: [redacted]

## VIBRATION DAMPING PROPERTIES

**Material Supplier:** EFTEC North America, LLC
**Sample Description:** EF3030 (3) **Cure Condition:** N/A
**Material Type:** Sprayon waterbase/extensional layer **Classification:** 89

| Sample Information | | Manf. Data | Measured Data | Steel Bar | Units |
|---|---|---|---|---|---|
| | Surface Wt: | 2.5 | 2.8 | 6.3 | $kg/m^2$ |
| | Density: | N/A | 594 | 7936 | $kg/m^3$ |
| | Thickness: | N/A | 4.4 | 0.8 | mm |

| TEST TEMPERATURE | MODE | Measured Data: RESONANT FREQUENCY $f_c$ (Hz) | Measured Data: COMPOSITE LOSS FACTOR $\eta_c$ | Computed Data: COMP. YOUNG'S MODULUS $E_c$ (Pa) | Computed Data: MATERIAL LOSS FACTOR $\eta_1$ | Computed Data: MAT. YOUNG'S MODULUS $E_1$ (Pa) |
|---|---|---|---|---|---|---|
| -10°C (14°F) | 2 | 200 | 0.022 | 4.58E+09 | 0.028 | 1.02E+09 |
| | 3 | 592 | 0.021 | 5.12E+09 | 0.026 | 1.17E+09 |
| | 4 | 1199 | 0.021 | 5.48E+09 | 0.026 | 1.27E+09 |
| | | | | | | |
| | | | | | | |
| | Interpolated | 200 | 0.022 | 4.58E+09 | 0.028 | 1.02E+09 |
| | | 400 | 0.021 | 4.92E+09 | 0.027 | 1.12E+09 |
| | | 800 | 0.021 | 5.28E+09 | 0.026 | 1.22E+09 |
| 10°C (50°F) | 2 | 172 | 0.103 | 3.41E+09 | 0.140 | 6.98E+08 |
| | 3 | 519 | 0.091 | 3.94E+09 | 0.119 | 8.43E+08 |
| | 4 | 1056 | 0.086 | 4.25E+09 | 0.110 | 9.28E+08 |
| | | | | | | |
| | | | | | | |
| | Interpolated | 200 | 0.101 | 3.48E+09 | 0.137 | 7.16E+08 |
| | | 400 | 0.094 | 3.81E+09 | 0.123 | 8.06E+08 |
| | | 800 | 0.088 | 4.13E+09 | 0.113 | 8.94E+08 |
| 25°C (77°F) | 2 | 119 | 0.254 | 1.62E+09 | 0.538 | 2.08E+08 |
| | 3 | 377 | 0.303 | 2.08E+09 | 0.520 | 3.30E+08 |
| | 4 | 759*1 | 0.349 | 2.19E+09 | 0.580 | 3.81E+08 |
| | 5 | 1402*1 | 0.311 | 2.74E+09 | 0.460 | 5.10E+08 |
| | | | | | | |
| | Interpolated | 200 | 0.275 | 1.81E+09 | 0.530 | 2.56E+08 |
| | | 400 | 0.307 | 2.09E+09 | 0.525 | 3.33E+08 |
| | | 800 | 0.346 | 2.24E+09 | 0.568 | 3.72E+08 |
| 40°C (104°F) | 2 | 98 | 0.097 | 1.10E+09 | | |
| | 3 | 289.4 | 0.155 | 1.23E+09 | | |
| | 4 | 570 | 0.240 | 1.24E+09 | | |
| | 5 | 1031*1.5 | 0.301 | 1.48E+09 | | |
| | 6 | | | 0.00E+00 | | |
| | Interpolated | 200 | 0.132 | 1.18E+09 | | |
| | | 400 | 0.191 | 1.23E+09 | | |
| | | 800 | 0.273 | 1.37E+09 | | |
| 60°C (140°F) | 2 | 91 | 0.039 | 9.46E+08 | | |
| | 3 | 261 | 0.050 | 9.97E+08 | | |
| | 4 | 518 | 0.064 | 1.02E+09 | | |
| | 5 | 866 | 0.075 | 1.05E+09 | | |
| | 6 | 1287 | 0.102 | 1.04E+09 | | |
| | Interpolated | 200 | 0.047 | 9.84E+08 | | |
| | | 400 | 0.058 | 1.01E+09 | | |
| | | 800 | 0.073 | 1.04E+09 | | |

*1- Based on 1 dB downpoint method
*1.5- Based on 1.5 dB downpoint method

Measurements Conducted per SAE J1637
Bar Free Length: 200 mm

Kolano and Saha Engineers, Inc.
Project No. 2001-189
Test Date [redacted]

# VIBRATION DAMPING PROPERTIES

**Material Supplier:** EFTEC North America, LLC
**Sample Description:** EF3030 (4) **Cure Condition:** N/A
**Material Type:** Sprayon waterbase/extensional layer **Classification:** 36

| Sample Information | | Manf. Data | Measured Data | Steel Bar | Units |
|---|---|---|---|---|---|
| | Surface Wt: | 4.4 | 4.0 | 6.3 | kg/m$^2$ |
| | Density: | N/A | 670 | 7936 | kg/m$^3$ |
| | Thickness: | N/A | 5.9 | 0.8 | mm |

| TEST TEMPERATURE | MODE | Measured Data: RESONANT FREQUENCY $f_c$ (Hz) | Measured Data: COMPOSITE LOSS FACTOR $\eta_c$ | Computed Data: COMP. YOUNG'S MODULUS $E_c$ (Pa) | Computed Data: MATERIAL LOSS FACTOR $\eta_1$ | Computed Data: MAT. YOUNG'S MODULUS $E_1$ (Pa) |
|---|---|---|---|---|---|---|
| -10°C (14°F) | 2 | 281 | 0.030 | 4.75E+09 | 0.034 | 1.19E+09 |
| | 3 | 872 | 0.033 | 5.85E+09 | 0.037 | 1.51E+09 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | Interpolated | 200 | 0.029 | 4.47E+09 | 0.033 | 1.11E+09 |
| | | 400 | 0.031 | 5.07E+09 | 0.035 | 1.28E+09 |
| | | 800 | 0.033 | 5.76E+09 | 0.037 | 1.48E+09 |
| 10°C (50°F) | 2 | 226 | 0.163 | 3.08E+09 | 0.191 | 7.28E+08 |
| | 3 | 722 | 0.147 | 4.00E+09 | 0.168 | 9.82E+08 |
| | 4 | 1399 | 0.160 | 3.92E+09 | 0.183 | 9.57E+08 |
| | | | | | | |
| | | | | | | |
| | Interpolated | 200 | 0.165 | 3.00E+09 | 0.193 | 7.05E+08 |
| | | 400 | 0.155 | 3.51E+09 | 0.179 | 8.43E+08 |
| | | 800 | 0.149 | 3.99E+09 | 0.170 | 9.78E+08 |
| 25°C (77°F) | 2 | 143 | 0.351 | 1.23E+09 | 0.518 | 2.23E+08 |
| | 3 | 474*1.5 | 0.458 | 1.72E+09 | 0.599 | 3.56E+08 |
| | 4 | 852*4 | 0.478 | 1.45E+09 | 0.662 | 2.82E+08 |
| | | | | | | |
| | | | | | | |
| | Interpolated | 200 | 0.378 | 1.35E+09 | 0.540 | 2.54E+08 |
| | | 400 | 0.441 | 1.64E+09 | 0.587 | 3.33E+08 |
| | | 800 | 0.476 | 1.48E+09 | 0.655 | 2.89E+08 |
| 40°C (104°F) | 2 | 109 | 0.148 | 7.12E+08 | | |
| | 3 | 324*2 | 0.224 | 8.08E+08 | | |
| | 4 | 628*3 | 0.262 | 7.89E+08 | | |
| | 5 | 1204*3 | 0.296 | 1.06E+09 | | |
| | 6 | | | 0.00E+00 | | |
| | Interpolated | 200 | 0.187 | 7.64E+08 | | |
| | | 400 | 0.235 | 8.02E+08 | | |
| | | 800 | 0.274 | 8.81E+08 | | |
| 60°C (140°F) | 2 | 97 | 0.071 | 5.70E+08 | | |
| | 3 | 282*4 | 0.090 | 6.12E+08 | | |
| | 4 | 561 | 0.109 | 6.31E+08 | | |
| | 5 | 939 | 0.131 | 6.46E+08 | | |
| | 6 | 1383*2 | 0.167 | 6.28E+08 | | |
| | Interpolated | 200 | 0.083 | 5.98E+08 | | |
| | | 400 | 0.099 | 6.22E+08 | | |
| | | 800 | 0.124 | 6.41E+08 | | |

*1.5-1.5dB downpoint method
*2- 2dB downpoint method
*3- 3dB downpoint one side method
*4- calculated from printout



Measurements Conducted per SAE J1637
Bar Free Length: 200 mm